I Claim:

1. A method of fabricating an optical waveguide comprising:

depositing an amorphous silicon film on a substrate; and

crystallizing selected regions of the amorphous silicon film to bound at least one non-selected region of the amorphous silicon film between the crystallized selected regions in alternating arrangement, wherein the crystallization reduces the refractive index of the selected regions below the refractive index of the at least one non-selected region.

2. The method of claim 1,

wherein the selected regions are crystallized by laser recrystallization using a pulsed laser.

3. The method of claim 2,

wherein the laser recrystallization utilizes a direct patterning technique selected from the group consisting of direct write, 1x projection imaging, and reduction imaging.

4. The method of claim 2,

further comprising controlling the laser to shape the energy profile irradiated on the amorphous silicon film so as to crystallize the selected regions into uniform guiding structures.

5. The method of claim 2,

further comprising controlling the laser to shape the energy profile irradiated on the amorphous silicon film so as to produce a desired boundary smoothness between the selected and non-selected regions.

6. The method of claim 2,

wherein the laser wavelength is less than about 600 nm and the laser pulse duration is less than about 100 nsec, for minimizing heating of the substrate.

7. The method of claim 1,

wherein the refractive index reduction of the crystallized selected regions occurs at least over the wavelength range between about 1.2 and about 1.6 microns.

8. The method of claim 7,

wherein the refractive indices of the crystallized selected regions and the non-selected regions differ by up to about twenty percent.

9. The method of claim 1,

further comprising capping the amorphous silicon film with a thin film capping layer.

10. An optical waveguide produced according to the method of claim 1,

wherein the amorphous silicon film has a monolithic thin film construction without bonds or seams between the crystallized selected regions and the at least one non-selected region.

11. A method of direct patterning an optical waveguide from an amorphous silicon film comprising:

spatially directing means for crystallizing amorphous silicon to crystallize selected regions of the amorphous silicon film on opposite sides of at least one non-selected region thereof so as to bound each non-selected region(s) between a pair of said crystallized selected regions in alternating arrangement, wherein said crystallization reduces the refractive index of the selected regions below the refractive index of the non-selected region(s).

12. The method of claim 11,

wherein the amorphous silicon crystallization means is a pulsed laser capable of melting and recrystallizing silicon.

13. The method of claim 12,

wherein the amorphous silicon crystallization means is directed to crystallize selected regions via a direct patterning technique selected from the group consisting of direct write, 1x projection imaging, and reduction imaging.

14. The method of claim 12,

further comprising controlling the laser to shape the energy profile irradiated on the amorphous silicon film so as to crystallize the selected regions into uniform guiding structures.

15. The method of claim 12,

further comprising controlling the laser to shape the energy profile irradiated on the amorphous silicon film so as to produce a desired boundary smoothness between the selected and non-selected regions.

16. The method of claim 12,

wherein the laser wavelength is less than about 600 nm and the laser pulse duration is less than about 100 nsec, for minimizing heating.

17. The method of claim 11,

wherein the refractive index reduction of the crystallized selected regions occurs at least over the wavelength range between about 1.2 and about 1.6 microns.

18. The method of claim 17,

wherein the refractive indices of the crystallized selected regions and the non-selected regions differ by up to about twenty percent.

19. The method of claim 11,

further comprising capping the amorphous silicon film with a thin film capping layer.

20. An optical waveguide produced according to the method of claim 11,

wherein the amorphous silicon film has a monolithic thin film construction without bonds or seams between the crystallized selected regions and the at least one non-selected region.

21. An optical waveguide comprising:

a monolithic structure having at least one as-deposited amorphous silicon (a-Si) core region, and at least one pair of annealed polycrystalline silicon (p-Si) cladding regions bounding the a-Si core region(s) on opposite sides thereof in alternating arrangement, said annealed p-Si cladding regions having a lower index of refraction than the a-Si core region(s).

22. The optical waveguide of claim 21,

wherein the monolithic structure is a thin film

23. The optical waveguide of claim 21,

further comprising a substrate on which the monolithic structure is deposition formed, said substrate having a lower index of refraction than the a-Si core region(s).

24. The optical waveguide of claim 23,

wherein the substrate comprises SiO_2.

25. The optical waveguide of claim 23,

further comprising a thin film capping layer sandwiching the monolithic structure between the thin film capping layer and the substrate.

26. The optical waveguide of claim 21,

wherein the lower refractive index of the annealed p-Si cladding regions enable waveguide operation in the wavelength range of about 1.2 and about 1.6 microns.

27. The optical waveguide of claim 26,

wherein the refractive indices of the annealed p-Si cladding and a-Si core regions differ by up to about twenty percent.

28. A patterned optical waveguide comprising:

a bondless and seamless monolithic thin film structure having *n* amorphous silicon core region(s) and *n+1* crystallized silicon cladding regions laser patterned in alternating arrangement with respect to the amorphous silicon core region(s), with said cladding regions having a lower refractive index than the amorphous silicon core region(s).

29. The patterned optical waveguide of claim 28,

further comprising a substrate on which the monolithic thin film structure is deposition formed, said substrate having a lower index of refraction than the amorphous silicon core region(s).

30. The patterned optical waveguide of claim 29,

wherein the substrate comprises SiO_2.

31. The patterned optical waveguide of claim 29,

further comprising a thin film capping layer sandwiching the amorphous silicon core region(s) between the thin film capping layer and the substrate.

32. The optical waveguide of claim 28,

wherein the lower refractive index of the crystallized silicon cladding regions enable waveguide operation in the wavelength range of about 1.2 and about 1.6 microns.

33. The optical waveguide of claim 32,

wherein the refractive indices of the crystallized silicon cladding regions and the amorphous silicon core region(s) differ by up to about twenty percent.